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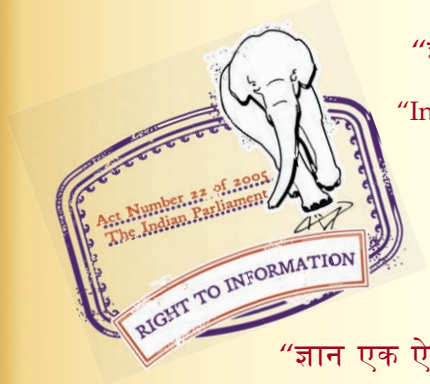

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Indian Standard

GUIDANCE FOR ENVIRONMENTAL TESTING

PART V RESISTANCE TO CLEANING SOLVENTS AND PERMANENCE OF MARKINGS

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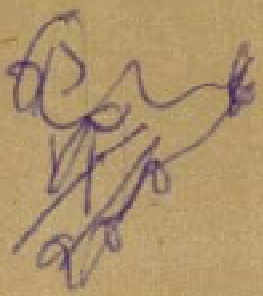

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GUIDANCE FOR ENVIRONMENTAL TESTING

PART V RESISTANCE TO CLEANING SOLVENTS AND PERMANENCE OF MARKINGS

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Indian Standard

GUIDANCE FOR ENVIRONMENTAL TESTING

PART V RESISTANCE TO CLEANING SOLVENTS AND PERMANENCE OF MARKINGS

0. FOREWORD

0.1 This Indian Standard (Part V) was adopted by the Indian Standards Institution on 1 September 1979, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard should be used with IS : 9000 (Part XX)-1979*, which contains the test for resistance to cleaning solvents and permanence of markings.

0.3 This standard is largely based on IEC Document 50C (Central Office) 19 ' Draft — Test XA: Immersion in cleaning solvents and guidance to test XA ' issued by the International Electrotechnical Commission.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard (Part V) deals with guidance for the test for resistance to cleaning solvents and permanence of markings for electronic and electrical items.

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*Basic environmental testing procedures for electronic and electrical items: Part XX Resistance to cleaning solvents and permanence of markings.

†Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.1 For the purpose of this standard, the terms and definitions covered in IS : 9000(Part I)-1977* shall apply.

3. GENERAL

3.1 Many components or parts especially those that are to be mounted on printed boards will be subjected to cleaning processes. During these cleaning processes, when components or parts may be immersed in certain solvents and may be rubbed or brushed, such items may be affected by the cleaning solvents or by mechanical stresses associated with rubbing or brushing or both. The marking on these items may also be affected by these solvents. To simulate effects of such cleaning operations and to verify the resistance to solvents and rubbing of components or parts and to check the permanence of markings, the test covered by IS : 9000 (Part XX)-1979† is to be applied.

The test contains the following two methods:

a) To determine the superficial effects on marking, encapsulation, coating, etc; and

b) To determine the effects on the characteristics of the item.

4. CLEANING

4.1 Generally the cleaning solvent used depends on soldering flux chosen. Soldered printed circuits, that is, boards plus components, may be cleaned in different ways. In many cases, total immersion of printed circuits in certain solvents is required. In those cases components on boards have to withstand a short-time immersion in the relevant cleaning solvent.

4.1.1 *Printed Circuits or Component Fluxed with Rosin-Based Fluxes*

4.1.1.1 These circuits or components may be cleaned effectively by fluorocarbon/alcohol mixtures as widely used and commercially available under different trade names. To remove fluxes and flux-residues, circuits are normally:

a) immersed in a cold solvent (at ambient temperature), or

b) immersed in a boiling solvent, or

c) successively immersed in a cold and boiling solvent.

*Basic environmental testing procedures for electronic and electrical items: Part I General.

†Basic environmental testing procedures for electronic and electrical items: Part XX Resistance to cleaning solvents and permanence of markings.

4.1.1.2 After immersion, boards or components may be rubbed or brushed, if necessary, to remove insoluble residues or certain sticky contaminants.

4.1.2 *Printed Circuits or Components Fluxed with Water-Soluble Fluxes* — These circuits are cleaned by warm water spraying or by immersion in warm water. After cleaning, rubbing or brushing may be applied.

5. CHOICE OF TEST SOLVENTS

5.1 To remove rosin-based fluxes and flux residues, in practice a great number of different organic cleaning solvents are used, some of them being highly aggressive, flammable or toxic.

5.2 Tests made by industries indicate that relatively mild solvents based on mixtures of 1, 1, 2 trichlorotrifluoroethane and alcohols give good cleaning results and do not affect most types of components and parts generally.

5.3 Two solvents, widely used in practice and well-matched to the principal types of fluxes, have been chosen as test solvents, namely:

a) a mixture of 1, 1, 2 trichlorotrifluoroethane, 70 $\pm$ 5 percent by mass; and propan-2-ol, 30 $\pm$ 5 percent by mass; and

b) water, demineralized or distilled quality, resistivity ·500 Ωm.

5.4 The mixture of 1, 1, 2 trichlorotrifluoroethane and propan-2-ol is used frequently because it provides the features of low-toxicity, non-flammability, stability and sufficient cleaning power.

NOTE — In technically justified cases, other solvents similar in activity to the recommended ones may be used as agreed to between the user and the manufacturer.

5.5 Other organic cleaning solvents, such as some hydrocarbons (petroleum spirit, benzene, toluene, etc) or chlorinated solvents (trichloroethane, trichloroethylene, perchloroethylene, dichloromethane, etc) are not chosen and are not recommended for cleaning operations considering toxic hazards, flammability hazards, insufficient stability or excessive aggressiveness damaging many components materials.

6. TEST CONDITIONS

6.1 The following test conditions have been selected to be realistic and to restrict the number of varieties of production cleaning conditions:

Solvent (1)	*Solvent Temperature* (2)	*Immersion Time* (3)	*Mechanical Treatment* (4)
i) Mixture of 1, 1, 2 trichlorotrifluoroethane and propan-2-ol	a) 25 ± 5°C	5 ± 0·5 min	Rubbing, if necessary
	b) Boiling temperature (48·6-50·5°C)	5 ± 0·5 min	Rubbing, if necessary
ii) Water	55 ± 5°C	5 ± 0·5 min	Rubbing, if necessary

6.2 The following may also be noted:

a) Application of *ultrasonic energy*, in association with immersion in a solvent is omitted as this test procedure is not intended to simulate effects of ultrasonic energy;

b) Relevant temperatures have been based on *usual cleaning procedures* to which solvents may be submitted;

c) Contact of 1, 1, 2 trichlorotrifluoroethane and propan-2-ol with the skin shall be avoided as, in common with other organic solvents, it can cause de-fatting of the skin leading to skin complaints;

d) Generally cleaning in practice is done by immersion of printed circuits in a solvent for 0·5 to 2 minutes to introduce some *overstress* an immersion time of 5 minutes is chosen;

e) During immersion of components or parts in solvents, solvent temperatures shall be measured. Temperatures shall be within the given limits. The boiling mixture of 1, 1, 2 trichlorotrifluoroethane propan-2-ol shall remain boiling;

f) The composition of the mixture of 1, 1, 2 trichlorotrifluoroethane and propan-2-ol will change due to evaporation. The propan-2-ol concentration will increase. When used at 25 ± 5°C, the composition should be checked immediately before and immediately after the test by measuring the density, using an accurate hydrometer.

Temperature	*Density Range* g/cm^3
20°C	1·16-1·25
25°C	1·15-1·24
30°C	1·14-1·23

When used at its boiling point, the composition should be checked continuously throughout the test, by measuring the boiling point which should be maintained between 48·6°C (*see* table below). To avoid changes in composition during the test, it will normally be necessary to use a simple condenser (*see* Fig. 1) to prevent excessive loss of the 1, 1, 2 trichlorotrifluoroethane component:

1, 1, 2 Trichlorotrifluoroethane Percent	*Propan-2-ol* Percent	*Boiling Point (at 101·3 kPa)* °C
75	25	48·6
60	30	49·2
65	35	50·5

7. RUBBING

7.1 In practice, after immersion in a cleaning solvent, boards and/or components may be rubbed or brushed to remove insoluble residues or certain contaminants. Therefore, the test procedure also mentions application of rubbing to simulate mechanical treatment in association with cleaning operations. Rubbing as test [*see* **7.1** of IS : 9000 (Part XX)-1979*] should be applied only if required by the relevant component or part specification.

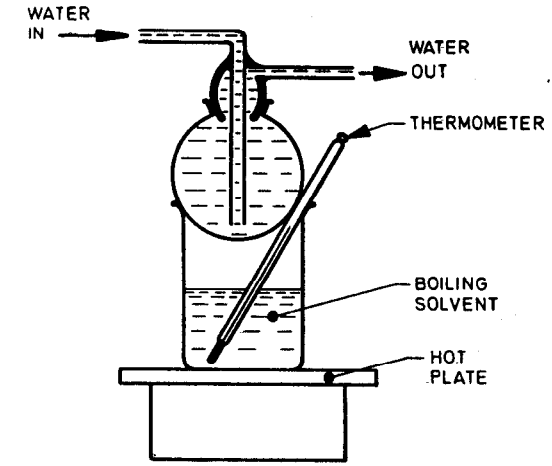
7.2 Although a reproducible and operator-independent rubbing method has not yet been established, **7.1** of IS : 9000 (Part XX)-1979* provides a simulation of stresses occuring in practice. Rubbing shall be applied to a dry surface because rubbing on a wet surface may lead to non-reproducible effects. Rubbing shall be done only to show that the marking will remain legible during usual printed circuit handling after cleaning procedures.

7.3 Materials — For reproducibility reasons cotton wool and wrapping tissue paper are chosen [*see* **7.1** of IS : 9000 (Part XX)-1979*] as these materials are best specified, everywhere available and give fairly reproducible rubbing conditions. Besides wrapping tissues paper as mentioned in **7.2** of IS : 9000 (Part XX)-1979*, commercially available paper handkerchiefs are accepted for testing.

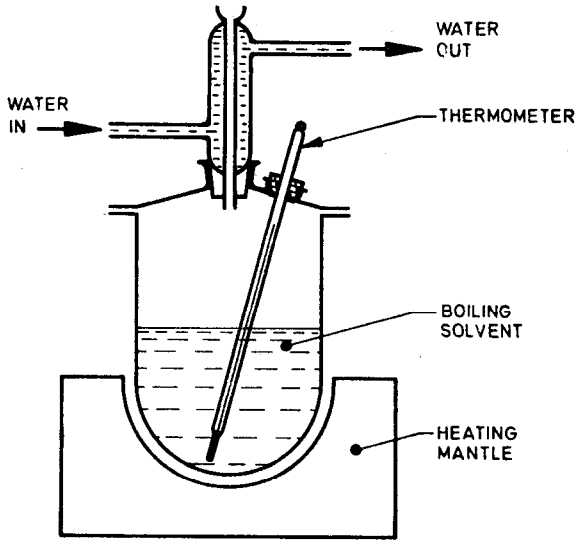
7.4 Force

7.4.1 *Manually* — When rubbing is done by hand pressure a force of about 5N is to be applied. Hand rubbing can be applied fairly

*Basic environmental testing procedures for electronic and electrical items : Part XX Resistance to cleaning solvents and permanence of markings.



1A TYPE 1



1B TYPE 2

FIG. 1 SUITABLE APPARATUS FOR BOILING SOLVENT TEST

reproducible with experience. Hand pressure may be checked by a springpressure gauge or balance.

7.4.2 *Applying a Test Fixture* — Rubbing can be applied also by a test fixture. The construction of such a fixture will depend on the shape of components or parts to be tested. Therefore no standardized fixture is given here.

7.5 Components with Sleeves — Components having insulation sleeves, for example, shrinkable plastic tubing or whose casings may otherwise include capillary tissues, may retain absorbed solvents over longer periods, thus producing long term effects.

8. PRACTICAL POINTS

8.1 Working Instructions — When cleaning solvents are used, the relevant safety precautions shall be observed.

8.2 Application of Different Test Conditions or Methods to the Same Type of Component — When a type of component or part is to be tested under different test conditions or methods, separate items should be used for each test.

8.3 Sample Arrangement — Components or different types may be tested simultaneously. For the test, components may be mounted on a piece of printed board or connected to a length of wire. During immersion, components shall not be in contact with each other to avoid non-reproducible mechanical effects.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2